

The background of the entire page is a high-speed photograph of water splashing, creating a dense, textured pattern of white droplets and bubbles against a light blue background. The splash appears to be coming from the bottom left and moving upwards and to the right.

# Volume 2

Chapter 9 Ecosystem Restoration



Ecosystem restoration improves the condition of our modified natural landscapes and biological communities and makes them more sustainable for the use and enjoyment by current and future generations.

# Chapter 9 Ecosystem Restoration

Ecosystem restoration can include changing the flows in streams and rivers, restoring fish and wildlife habitat, controlling waste discharge into streams, rivers, lakes or reservoirs, or removing barriers in streams and rivers so salmon and steelhead can spawn. Ecosystem restoration improves the condition of our modified natural landscapes and biotic communities to provide for the sustainability and for the use and enjoyment of those ecosystems by current and future generations. Healthy aquatic and wetland ecosystems benefit California's native plants and wildlife and its society and economy.

Many of California's ecosystems cannot be restored to their natural state, nor is that degree of restoration desirable. Instead, ecosystem restoration focuses on rehabilitating ecosystems so that they supply important elements of their original structure and function in a sustainable manner. Ecosystem restoration and protection can be viewed as the proper maintenance of California's natural infrastructure.

Over the past couple of decades, the public has recognized the need to restore California's ecosystems. The desire to improve the conditions of those ecosystems was supported by the passage of bond issues, such as Propositions 204, 13 and 50. Local and regional restoration projects have multiplied. There are watershed alliances and regional ecosystem projects throughout the state, including on the Los Angeles, San Joaquin, Truckee, Carmel, Sacramento, and Trinity rivers. Some of these projects are described in the regional reports of Volume 3. Most rural private lands provide wildlife habitat. See the agricultural land stewardship strategy for information of agricultural practices that preserve and enhance habitat conditions.

The decade prior to publication of this update saw a remarkable transformation in water management in California. In 1993, water management was characterized by lawsuits, policy gridlock, and conflicts between those who sought to improve water supply reliability and those who sought to protect threatened and endangered species. Since 1995, the California Bay-Delta Program has been working towards improving water supply reliability while restoring ecosystems.

Land development projects and water development projects have often had significant, if unanticipated, environmental impacts. Today, planning must include investment to prevent ecosystem damage and long-term maintenance costs. Future water projects could face conflict and opposition if they do not protect and restore the ecosystem. And water projects can help restore ecosystems because they can help ensure flows in streams and rivers at flow rates and patterns to facilitate restoration actions.

This strategy focuses on restoration of aquatic ecosystems because these are the ecosystems most likely to be affected by water management.

## California's Ecosystems and Restoration

*California Rivers*, A Public Trust Report (State Lands Commission, 1993) concluded that the health of California's rivers is stressed and their viability as sustainable ecosystems is in peril. The report urged State agencies to undertake a comprehensive program of river basin and watershed protection and restoration. The same conclusions apply to many of California's other aquatic ecosystems, including bays, estuaries, and lakes. More recently, the California Bay-Delta Program plan for ecosystem restoration has presented broad goals, many specific objectives, and a prioritized list of actions to restore biological diversity within its geographic scope. Over the past decade, Californians have invested hundreds of millions of dollars in ecosystem restoration.

The condition of California's fisheries reveals the need for additional improvement. Thirty-three fish populations are listed as threatened or endangered in California, with some in each of the hydrologic regions described in Volume 3. These populations include coastal and Central Valley runs of steelhead; spring-run and winter-run Central Valley Chinook salmon; Delta smelt; three species from the Colorado River; and several minnows, pupfish and suckers from the Klamath basin and southern deserts.

Hydraulic mining and gold extraction in the 1800s, dam construction and operation, pollution, flood control, urbanization, increases in Delta exports and upstream diversions, and introduction of exotic species have all contributed to the decline in ecosystem health. Ecosystem changes have caused a sharp decline in the abundance of things that society values, such as native and some non-native fish species. Ability to sustain all life stages of native fish is an example of a function that California rivers no longer provide as well as they once did. People have also affected the structure of ecosystems. For example, rivers downstream of dams are deprived of the gravel supply from upstream that provides spawning habitat for species such as Chinook salmon.

The California Environmental Quality Act recognizes that human activity may have unintended environmental impacts, and outlines procedures for project proponents to avoid, minimize, and mitigate these impacts. Mitigation of environmental impacts has become common in California. Mitigation is similar to ecosystem restoration, but mitigation is intended to bring the level of ecosystem health back to what it was before impacts of a project occurred. By contrast, ecosystem restoration is intended to raise the level of ecosystem health.

Construction of major dams, increased exports through the Delta, or small local projects have been opposed for their potential impacts to the environment. It may not be possible to fully mitigate some of the impacts of new projects. When negative impacts occur in aquatic ecosystems that are already severely degraded, it may be difficult to avoid endangered species conflicts.

More recently, resource managers have concluded that the most successful way to pursue either aquatic ecosystem restoration or water management is to integrate the two. This integration of project goals has the potential to reduce the conflict over water management actions, increase the support for ecosystem restoration and provide a more cost effective solution.

Within State government, several departments and boards share public trust responsibilities. The Department of Fish and

Game coordinates, oversees, funds, and carries out restoration activities and plays a central role in carrying out public trust responsibilities. The State Water Resources Control Board is responsible for regulating water rights and establishing standards for minimum stream flows. The Department of Water Resources, as the operator of the State Water Project, can propose, design, build, and operate water management facilities in ways that improve water supply reliability while restoring ecosystem health and protecting public trust values. One of these agencies cannot be completely successful unless there is collaboration among all. See Volume 1, Chapter 2, for details on the public trust doctrine and values.

## Benefits of Ecosystem Restoration

Restoration can improve plant and animal life, increase diversity and connectivity of habitat, help endangered species, and improve watersheds. Restoration can rehabilitate natural processes to support native communities with minimal ongoing help. Restored habitats are likely to help sustain reproduction, foraging, shelter, and other needs of fish and wildlife species. By broadening restoration to the ecosystem level, rather than focusing on restoration for only a handful of species, we improve our chances for long-term success by incorporating species relationships, such as between predators and prey, physical processes, genetic variability, and other factors that we don't fully understand.

The state's ecosystems, from mountain watersheds to coastal beaches, are California's natural infrastructure, and support our population and economic growth. Ecosystem restoration is an investment in improving the condition of California's natural infrastructure. As understanding of the linkage between water management and the health of the natural infrastructure grows, the benefits of restoration to water supply reliability and water quality improvements are increasingly evident. As ecosystem restoration actions help increase the health and abundance of species protected under the State and federal Endangered Species Acts, there might be fewer ESA conflicts. As ecosystems such as wetlands and sloughs are restored, their natural pollutant filtering capabilities can improve water quality. As floodplains and seasonal lakes and ponds are restored, groundwater recharge can increase. The result will be a more reliable, higher quality water supply supported by a sustainable ecosystem.

The economic benefits that improved rivers, estuaries, wetlands, wildlife, beaches, and their surrounding habitats can have in the state may far exceed the investments for restoring ecosystems. Considering California lifestyle trends and travel and tourism as the major growth industry for the state, investments

in ecosystem restoration actions may provide a high return on investment. Second only to the state's beaches, rivers are the biggest attraction for California's recreation industry. Similarly, managed wetlands and wildlife refuges provide bird watching and hunting opportunities that contribute hundreds of millions of dollars annually to California's economy.

## Costs of Ecosystem Restoration

Detailed statewide ecosystem needs and their costs does not exist. However, it is likely that the costs of restoration are higher than the costs of protecting existing healthy ecosystems. Preliminary estimates indicate that ecosystem costs to 2030 could total \$7.5 billion to \$11.3 billion<sup>1</sup>. Costs of restoration can include research and monitoring, acquisition of land and water, cultivation and planting of native vegetation, and physical alteration of the landscape. The costs of river restoration can increase dramatically when channel alteration is required, such as filling in gravel pits or re-grading incised banks.

Since 1996, California voters have approved four bond issues that include funds to restore animal and plant life. As of the end of 2003, the California Bay-Delta Program has funded 400 projects at a cost of \$490 million, and has committed \$150 million per year toward ecosystem restoration.

Supplying water for ecosystem needs is often viewed as competing with supplying water for human needs, or responsible for increasing the cost of supplying human needs. While there

are limits to the amount of water that can be withdrawn from a river ecosystem before its health and productivity is compromised, experience with integrating ecosystem restoration and water supply management is demonstrating their compatibility in many cases. As an example, in years 2001 through 2003 the Environmental Water Account of the California Bay-Delta Authority acquired about 900,000 acre-feet of water, at a cost of about \$140 million, to protect at-risk fish species.

## Major Issues Facing Implementation of Ecosystem Restoration

The major threats to aquatic and riparian habitat and freshwater biodiversity in California stem from physical changes associated with dams, diversions, and erosion protection for levees and banks; poor water quality, including temperature, dissolved oxygen levels and pollutants; and non-native invasive species. These issues are outlined further in the strategies for floodplain management, pollution prevention and watershed management in this volume. Beyond those direct physical changes, this section describes other issues and challenges facing restoration efforts.

## Integrated Resources Planning

Unlike planning that is conducted for only a single-purpose, multipurpose planning that incorporates diverse interests can take longer, cost more and require better knowledge of key ecological elements and processes.

### Box 9-1 Sources of Ecosystem Data

Information on restoration projects, biological resources, and organizations involved in restoration can be found for many parts of the state. The Information Center for the Environment (ICE) is a cooperative effort of environmental scientists at the University of California, Davis, and collaborators at more than 30 private, State, federal, and international organizations interested in environmental protection. ICE has developed the Natural Resources Projects Inventory, a database of information on thousands of conservation, mitigation and restoration projects being developed and implemented throughout California. Also, the California Environmental Resources Evaluation System is an information system developed by the Resources Agency to facilitate access to a variety of electronic data describing California's rich and diverse environments. The California Legacy Project, a part of CERES, has supported conservation investment decisions in numerous ways, including: (1) identified a long-range strategy to conserve the most important natural resources in California; (2) assembled a digital atlas of key resources and stressors; and (3) reported on the status and trends of those resources.

<sup>1</sup> Cost estimate = \$7.5 billion – \$11.25 billion, as follows: (\$150 million/year for CALFED activities) X (25 years until 2030) = \$3.75 billion for CALFED area. (\$3.75 billion) X (an expansion factor of 2 or 3 to cover areas outside CALFED) = \$7.5 billion – \$11.3 billion

## Assessment of Environmental Water Flows

Knowledge of effects of different flows on the health of aquatic and riparian ecosystems is incomplete. Data and analytical tools to measure the adequacy of flows are insufficient.

## Scientific Uncertainty

Restoration science is a work in progress. Rarely do we have all the scientific information on a species, much less an ecosystem, to identify an exact course of action that will restore natural communities and processes. When precious resources and endangered species are involved, we often do not have the time or money to fully develop our scientific understanding before action is needed. Yet, the uncertainty can lead to hesitation and delay.

## Sound, Accessible Data

We need more data about ecosystem health so we know where to invest public funds. There is no complete inventory of ecosystems and their health. Key criteria to prioritize conservation actions are lacking, scattered or incompatible for comparison. There is also no reporting system and incomplete metrics for evaluation of the outcome of various restoration and management strategies.

## Effectiveness and Efficiency of Restoration Actions

The effectiveness and efficiency of actions taken to restore and protect aquatic ecosystems is often complex and difficult to measure. Effectiveness is the amount of benefit gained such as an increase in abundance of a species. Efficiency can be thought of as the effectiveness per unit of expenditure (e.g., money or water). Effectiveness and expenditure may not correspond one-to-one, often because factors other than the amount of funding or amount of water influence the degree of restoration achieved. The perception of wide variations in efficiency motivates a search for the more efficient alternatives. Without agreement on which alternatives those might be, opposition to further commitments, especially of water, will continue.

## Funding Uncertainty

Ecosystem restoration efforts are often long term and need long-term financing. Although public funds are available, they may be sporadic and thus unreliable, and are subject to intense competition.

## Gravel and Sediment

Dams retain sediment, including gravel, which is a critical element in river ecosystems. Furthermore, conventional

bank protection prevents the erosion that could provide a local supply. Without a natural mechanism for replenishment of sediment, gravel must come from elsewhere. Locating sediment sources, mining gravel without causing more environmental damage and paying for long-term sediment management are significant challenges to restoring the natural functions and values of rivers below large dams.

## Recommendations for Ecosystem Restoration

1. DWR, DFG and SWRCB should work together to publish comprehensive assessments of in-stream flow needs on California rivers, similar in scope to studies on the Feather and American rivers. The assessments should identify bodies of water that need improved flows, in terms of volume, timing, duration, etc.
2. The Resources Agency and Cal-EPA should work with their respective departments, boards and commissions to ensure and promote use of independent science to inform their decision-making.
3. The Resources Agency should continue to support development and use of statewide databases, analytical tools and evaluation criteria, such as the Natural Resource Project Inventory and a follow-up to the Legacy project, that can provide information to planners and decision-makers and identify priorities for restoration. This investment should provide a coordinated and comprehensive statewide implementation plan for restoration actions in each region.

*DWR will incorporate ecosystem restoration as an objective in water management projects, or will partner with restoration projects, to achieve net environmental benefit from water management actions. This is consistent with the commitments that DWR has made in the California Bay-Delta Program. DWR will develop guidelines for helping local water managers and planners pursue the same multiple-objective approach, including incorporation of fish and wildlife benefits into projects. See Volume 1, Chapter 2, for more recommendations to promote integrated resource planning.*

4. The Resources Agency should support further scientific research on the relationship between flow dedication and water-independent actions to achieve desired restoration. A step in this direction was the publication of a report by Deason et al. (2004) of the Graduate School of Public Policy at UC Berkeley, "Considering water use efficiency by the environmental sector." The report (see Volume 4) identifies ways to measure and compare—albeit in general terms—the efficiency of different uses of managed environmental water.
5. The Department of Fish and Game, with the Department of Conservation and DWR, should investigate and resolve key issues regarding long-term coarse sediment supplies for ecosystem needs. This investigation should identify sources of sediment, replenishment processes that will sustain themselves and potential mercury contamination.

## Selected References

- California State Lands Commission. 1993. California Rivers, A Public Trust Report. 334 p.
- California Department of Fish and Game. 2003. California's Plants and Animals. [www.dfg.ca.gov/hcpb/species/t e spp/tespp. Shtml](http://www.dfg.ca.gov/hcpb/species/t e spp/tespp. Shtml)
- CALFED Bay-Delta Program. 2000. Strategic Plan for Ecosystem Restoration. x, 73 p.